TRANSPORTATION ANALYSIS SIMULATION SYSTEM (TRANSIMS)

VERSION 1.0

UNDERSTANDING TRANSIMS OUTPUT FILES

March 1998

[Tab 3]

Contents

1. FORMAT OF PLAN SET FILES

TRANSIMS plan files contain a description of the route through the road network that each traveler intends to take during the traffic microsimulation. The files are space-delimited ASCII text files with arbitrary line breaks; each plan may span several lines in the file. The first set of lines of the plan file gives the field names. The plans are stored sequentially in the file, and each plan is separated by a blank line.

A plan file starts with a header section identifying the plan and the general characteristics of the plan. Table 1 shows the fields present in the header. For each step in the plan (given by the "NO. OF STEPS" field in the plan header), the plan body fields listed in Table 2 are repeated. Finally, the plan ends with the two fields of the plan trailer summarized in Table 3.

Table 1: Fields present in plan headers

Field	Description
PLAN NO.	A unique integer identifying the plan
MODE	The travel mode (currently always zero)
VEHICLE ID	A unique integer identifying the vehicle
DRIVER PLAN NO.	A unique integer identifying the driver
START NODE	The ID of the network parking location where the route starts
NO. OF STEPS	The number of links traversed by the route

Table 2: Fields present in plan bodies

Field	Description
LINK	The ID of the network link on which the vehicle is traveling
START TIME	The expected time (in seconds past midnight) that the vehicle will arrive on the link

Table 3. Fields present in plan trailers

Field	Description
END NODE	The ID of the network parking location where the route ends
ARRIVAL TIME	The expected time (in seconds past midnight) that the vehicle will arrive at the parking location

2. FORMAT OF MICROSIMULATION OUTPUT FILES

The simulation output subsystem collects data from a running microsimulation, stores the data for future use, and manages the subsequent retrieval of the data. The user may specify what data is collected and retrieved; the data may also be filtered by space and time.

The output subsystem currently can collect three types of data: snapshot (trajectory) data, event data, and summary data. Any number of each of these may be collected simultaneously in a simulation.

1) *Snapshot data* provides the most detailed information about how the state of the microsimulation evolves in time. The vehicle data for links consists of the location, velocity, and status of each vehicle; this provides a complete *trajectory* for each vehicle in the simulation. The vehicle data for intersections consists of the location of the vehicle within the intersection buffer. The traffic control data simply reports the current phase and allowed movements at the traffic control. Snapshot data may be collected for each time step; the data is not summarized (i.e., totaled or averaged) in any way.

2) *Event data* supplies information on exceptional conditions of vehicle status. Examples include when a vehicle becomes lost (unable to follow its plan), when the plan for a vehicle is invalid, and when the vehicle enters or exits the study area. Event data is collected only when an event occurs.

3) *Summary data* reports aggregate data about the simulation. The link travel time data consists of counts of vehicles exiting links and means and variances of the vehicle traversal times for those links. Link density data provides counts and mean velocities of vehicles in variably-sized *boxes* that partition links. Summary data is sampled and reported periodically throughout the simulation.

The TRANSIMS Analyst Interface (TAI) allows the user to specify what data is collected and retrieved, and to filter it by space and time. Users can configure the subsystem to collect a wide variety of trajectory, event, and summary data from the simulation. Figure 1 shows an example of how data collection can be configured. Table 4 lists the user-configurable parameters for output collection; a user can also select which network nodes and links output is collected on. See Tab 2, Section 1 for detailed instructions on setting up output collection parameters in the TAI.

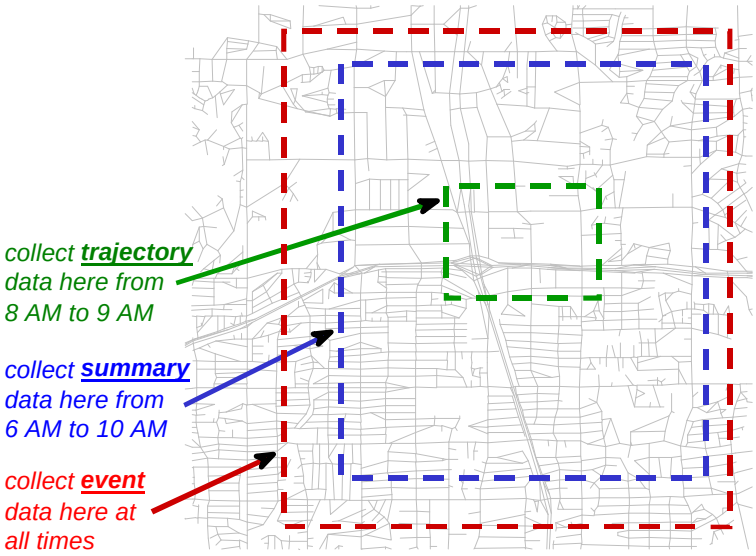

Figure 1: Example of how data collection can be filtered by space and by time

Table 4: User-configurable parameters for microsimulation output collection

Parameter	Interpretation
TIMEMIN	The first time (in seconds from simulation start) at which to collect data
TIMEMAX	The last time (in seconds from simulation start) at which to collect data
TIMESTP	The frequency (in seconds) at which to report data (i.e., write it to disk)
TIMESMP	The frequency (in seconds) at which to accumulate sample data
BOXLEN	The length of the boxes used for summary data

The output collection capabilities have been put to a wide variety of uses in the first TRANSIMS case study. Snapshot data was used for animating vehicle movement, making periodic snapshots of the traffic, understanding the traffic behavior induced by cellular automaton microsimulation rules, refining the driving logic, and deriving fundamental diagrams. Event data has helped to locate problems with network data, driver logic, and plans, and to record the entry and exit times of vehicles in and out of the study area. Summary data provided a means to animate vehicle densities, identify congestion and deadlocks, and replan trips using observed link travel times.

2.1 Types of Output

All of the TRANSIMS microsimulation output data files are in a tab-delimited ASCII text format with one data record per line of the file. The first line of the data file provides the names of the data fields in the order that the data for those fields appears in the subsequent lines.

2.1.1 Snapshot Data

Vehicle snapshot data files have the storage file suffix `.veh.txt`. Table 5 lists the fields present in such files; each record in the file represents a single vehicle. The data reporting start

time, finish time, and reporting frequency is given by the TAI's output specification. The output specification also determines on which links the data is collected.

Table 5: Data format for vehicle snapshot storage (`.veh.txt`) files

Field	Interpretation
STATUS	The vehicle status bits representing the state of the vehicle; these are additive. 1: The vehicle is off-plan. 2: The vehicle is at a dead end. 4: The vehicle has just entered the study area. 8: The vehicle has just exited the study area. 16: The vehicle is in the study area. 32: The vehicle has an invalid plan. See Section 2.2 for a discussion concerning the interpretation of this data.
LANE	The number of the lane on which the vehicle was traveling
TIME	The time the data was taken (in seconds from simulation start)
VELOCITY	The velocity (in meters per second) the vehicle was traveling
NODE	The node the vehicle was traveling away from
DISTANCE	The distance (in meters) the vehicle was away from the setback of the node from which it was traveling away
VEHICLE	The vehicle id
LINK	The link on which the vehicle was traveling

Intersection snapshot data files have the storage file suffix `.int.txt`. Table 6 lists the fields present in such files; each record in the file represents a single vehicle. The data reporting start time, finish time, and reporting frequency are given by the TAI's output specification. The output specification also determines on which nodes the data is collected.

Table 6: Data format for intersection snapshot storage (`.int.txt`) files

Field	Interpretation
QINDEX	The vehicle position in the queue
LANE	The number of the lane from which the vehicle entered
TIME	The time the data was taken (in seconds from simulation start)
NODE	The node where the vehicle is located
VEHICLE	The vehicle id
LINK	The link from which the vehicle entered

Signal snapshot data files have the storage files suffix `.sig.txt`. Table 7 lists the fields present in such files; each record in the file represents an incoming lane at an intersection. The data reporting start time, finish time, and reporting frequency are given by the TAI's output specification. The output specification also determines on which nodes the data is collected.

Table 7: Data format for signal snapshot storage (`.sig.txt`) files

Field	Interpretation
LANE	The number of the lane entering the signal
TIME	The time the data was taken (in seconds from simulation start)
NODE	The node where the signal is located
SIGNAL	The type of control present: 0: None 1: Stop 2: Yield 3: Wait 4: Caution 5: Permitted 6: Protected
LINK	The link entering the signal

2.1.2 Event Data

Vehicle event data files have the storage file suffix `.evt.txt`. Table 8 lists the fields present in such files; each record in the file represents a single vehicle event. The data reporting start time, finish time, and reporting frequency are given by the output specification. This data is collected for all links—i.e., the output link specification is ignored.

Table 8: Data format for vehicle event storage (`.evt.txt`) files

Field	Interpretation
STATUS	The vehicle status bits representing the events that occurred; these are additive. 1: The vehicle is lost. 2: The vehicle is at a dead end. 4: The vehicle has just entered the study area. 8: The vehicle has just exited the study area. 16: The vehicle is in the study area. 32: The vehicle has an invalid plan. See Section 2.2 for a discussion concerning the interpretation of this data.
LANE	The number of the lane on which the vehicle was traveling
TIME	The time the data was taken (in seconds from simulation start)
VELOCITY	The velocity (in meters per second) the vehicle was traveling
NODE	The node from which the vehicle was traveling away
DISTANCE	The distance (in meters) the vehicle was away from the setback of the node from which it was traveling away
VEHICLE	The vehicle id
LINK	The link the vehicle was traveling on

Note that all vehicles on the network will have an exit event recorded in the event file when the simulation ends. These vehicles will not have completed their trips even though the vehicle status will indicate that they exited from the simulation. The TIME for these exit events will be one timestep past the simulation end time.

2.1.3 Summary Data

Link space summary data files have the storage file suffix `.box.txt`. Table 9 lists the fields present in such files; each record in the file represents the summary for a single *box* on a link. If there is a short box, it is at the beginning of the link. The beginning distance of the box, which is not written in the file, is the ending distance of the box minus the box size. The data reporting start time, finish time, the sampling frequency, the data reporting frequency, and the box size are given by the TAI's output specification. The output specification also determines on which links the data is collected. Note that no data is reported at the reporting start time. Also, there may be two entries for links that are split by a CPU boundary. When this occurs, it is necessary to add the respective `COUNT` and `SUM` entries for the duplicate box records.

Table 9: Data format for link space summary storage (`.box.txt`) files

Field	Interpretation
SUM	The sum of the vehicle velocities (in meters per second) in the box
TIME	The time the data was taken (in seconds from simulation start)
NODE	The node from which the vehicles were traveling away
DISTANCE	The ending distance of the box (in meters) from the setback of the node from which the vehicles were traveling away
COUNT	The number of vehicles in the box
LINK	The link being reported

Link time summary data files have the storage file suffix `.tim.txt`. Table 10 lists the fields present in such files; each record in the file represents the summary for a single direction of a link. The data reporting start time, finish time, and reporting frequency are given by the TAI's output specification. The output specification also determines on which links the data is collected. Note that no data is reported at the reporting start time. Also, there may be two entries for links that are split by a CPU boundary. When this occurs, it is necessary to add the respective `COUNT`, `SUM`, and `SUMSQUARES` entries for the duplicate link records.

Table 10: Data format for link time summary storage (`.tim.txt`) files

Field	Interpretation
SUM	The sum of the vehicle travel times (in seconds) for vehicles leaving the link. The time spent in the previous intersection is included in this value.
TIME	The time the data was taken (in seconds from simulation start)
NODE	The node from which the vehicles were traveling away
SUMSQUARES	The sum of the vehicle travel time squares (in seconds squared) for vehicles leaving the link. The time spent in the previous intersection is included in this value.
COUNT	The number of vehicles leaving the link
LINK	The link being reported

2.2 Interpretation of Vehicle Status Bits in Event and Snapshot Data

When an event occurs, it is recorded in the vehicle status field by setting individual bits in the field. Currently, six events are recorded and, consequently, six bits (i.e., 2^0 through 2^5) in the field are used:

- *OffPlan [1]*: The vehicle is unable to follow its plan. This event may occur when a vehicle is unable to execute lane changes to make the appropriate turns at intersections in order to follow its plan. The event may also occur when a vehicle decides to abandon its plan because link congestion has prevented movement for long periods of time.
- *AtDeadEnd [2]:* The vehicle is on a link with no connectivity to any other links.
- *Entry [4]*: The vehicle has entered the study area. A vehicle can enter the study area from a parking lot on a study area link. A vehicle can also enter the study area by traveling from a buffer area link to a study area link.
- *Exit [8]*: The vehicle has exited the study area. A vehicle can exit the study area by entering a parking lot on a study area link or by traveling from a study area link to a buffer area link.
- *InStudyArea [16]*: The vehicle is in the study area. This bit remains set as long as a vehicle is traveling on a study area link.
- *BadPlan [32]*: The vehicle has an invalid plan. This event occurs when an error, such as a link sequence, in the plan is detected where there is no connectivity between the links in the transportation network.

A vehicle can enter the microsimulation in three ways:

1) The vehicle is on a study area link at the simulation start time. (*Entry & InStudyArea,* Status value = 20)
2) The vehicle enters the study area by leaving a parking location. (*Entry & InStudyArea,* Status value = 20)

3) The vehicle crosses the boundary into the study area from the outside. (*Entry & InStudyArea*, Status value = 20)

A vehicle can leave the microsimulation in four ways:

1) The vehicle is in the study area when the simulation ends. (*Exit & InStudyArea*, Status value = 24)

2) The vehicle leaves the study area by entering a parking location. (*Exit & InStudyArea*, Status value = 24)

3) The vehicle crosses the boundary out of the study area to the outside. (*Exit & InStudyArea*, Status value = 24)

4) The vehicle reaches a dead end within the study area. (*Exit & InStudyArea & AtDeadEnd*, Status value = 26)

The combination (*Entry & Exit & InStudyArea*, Status value = 28) only occurs for vehicles that enter the study area just as the simulation ends. The *OffPlan* and *BadPlan* status values can be combined with any other status values except each other (even if the vehicle is not in the study area). An *OffPlan* status value adds 1 to the previously listed status values. *A BadPlan* status value adds 32 to the previously listed status values. Similarly, *AtDeadEnd* may occur in combination with any other status, but never by itself. *AtDeadEnd* adds 2 to the other status values.

Table 11 summarizes the possible vehicle status values *for vehicle event data records.* In general, any status between 0 and 63 (i.e., any combination of status bits) can occur *for vehicle snapshot data records.*

Table 11: Possible status values for vehicle event data records

Bad Plan	InStudy Area	Exit	Entry	AtDeadEnd	OffPlan	Vehicle Status
					X	1
				X	X	3
	X					16
	X				X	17
	X			X		18
	X			X	X	19
	X		X			20
	X		X		X	21
	X		X	X		22
	X		X	X	X	23
	X	X				24
	X	X			X	25
	X	X		X		26
	X	X		X	X	27
	X	X	X			28
	X	X	X		X	29
	X	X	X	X		30
	X	X	X	X	X	31
X						32
X				X		34
X	X					48
X	X			X		50
X	X		X			52
X	X		X	X		54
X	X	X				56
X	X	X		X		58
X	X	X	X			60
X	X	X	X	X		62

A "normal" trip through the study area, for example, will have two events recorded for the vehicle:

1) *Entry* & *InStudyArea*, Status value = 20

2) *Exit* & *InStudyArea*, Status value = 24

Note that vehicles with status values of 24 at one time step past the end of the simulation do *not* represent a completed trip; instead, these are the vehicles that were traveling on the network when the simulation ended. Future versions of TRANSIMS will have a status that differentiates between normal vehicle exit and vehicles on the transportation network when the simulation ends.

Another example is a vehicle that becomes off-plan after entering the study area; such a vehicle would have three events recorded:

1) *Entry & InStudyArea*, Status value = 20

2) *OffPlan & InStudyArea*, Status value = 17

3) *OffPlan & Exit & InStudyArea*, Status value = 25.

Some common status values found in vehicle snapshot data records are:

- *0:* The vehicle is traveling normally in the buffer area.
- *1 [OffPlan]:* The vehicle is off-plan in the buffer area.
- *2 [AtDeadEnd]:* The vehicle is at a dead end in the buffer area.
- *8 [Exit]:* The vehicle is exiting the simulation from the buffer area.
- *9 [Exit & OffPlan]:* The vehicle is exiting the simulation from the buffer area and it is off-plan.
- *16 [InStudyArea]:* The vehicle is traveling normally in the study area.
- *17 [InStudyArea & OffPlan]:* The vehicle is off-plan in the study area.
- *20 [Entry & InStudyArea]:* The vehicle is entering the study area.
- *48 [InStudyArea & BadPlan]:* The vehicle is on a bad plan in the study area.

In the above, "exiting" means either

- the simulation is ending,
- the vehicle is parking,
- the vehicle is moving into the buffer area, or
- the vehicle stops at a dead end

and "entering" means either

- the simulation is starting,
- the vehicle is leaving a parking place, or
- the vehicle is moving from the buffer area.